

RAND

*Mobilization and
Train-Up Times for Army
Reserve Component
Support Units*

*Thomas F. Lippiatt, J. Michael Polich,
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Prepared for the United States Army

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PREFACE

This report documents RAND research into the time it takes Reserve Component (RC) support units to mobilize and prepare for deployment. The analyses are based on empirical data from 606 units that were called to duty during the Persian Gulf War in Operation Desert Shield. They provide a systematic method for estimating the post-mobilization preparation times of diverse types of support units, such as artillery, engineering, transportation, chemical, and military police units. The results will allow defense analysts and planners to determine whether particular types of RC units can be available in time to respond to future contingencies.

This research was performed within the RAND Arroyo Center's Manpower and Training program and was sponsored by U.S. Army Forces Command.

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SUMMARY

This report documents results of RAND research into the time it takes to mobilize and prepare Army Reserve Component (RC) support units for deployment. The capability of RC units is a central issue in designing the future structure of the Army in light of the coming reductions in the Active Component (AC) and the overall shift toward contingency operations as the focus of U.S. military planning. Given the sometimes fast-evolving character of contingencies, the key questions are: How quickly can RC units be available after they are mobilized, and what deployment timelines can they meet?

This report estimates post-mobilization preparation time for RC support units. Support units, as defined here, constitute "combat support" and "combat service support" formations located at Echelons Above Division (EAD) and Echelons Above Corps (EAC).

DATABASE AND APPROACH

Our analyses of support functions include statistical modeling of preparation times for RC support units that were called to duty during the Persian Gulf War. The data include 606 units and cover such functions as artillery, engineering, transportation, chemical, and military police. We carried out a series of regression analyses to predict the time from call-up to critical time-points in the mobilization process (such as the time the unit was "validated" as ready for deployment and the time it was ready to load equipment for overseas transportation). The analyses identified three key factors that were associated with varying preparation times: the unit's branch, size (weight of equipment), and mode of transportation (by air or sea).

RESULTS

Mobilization and preparation for deployment is a multistep process, which we have broken into several key phases with time estimates for each. Typically, a unit first mobilizes at its home station, moves to a mobilization station, prepares individuals and equipment for overseas movement, conducts collective training to reach standard levels of proficiency on wartime tasks, and is "validated" as ready for deployment. The unit then moves to its Air or Sea Port of Embarkation, from which it transits to the overseas theater.

Our data indicated that the time required for the early phases was similar for all units (3 days from call-up to assemble and reach the mobilization station, and 1 to 3 days to prepare for overseas movement). The analyses showed that the time required for the other phases varied, depending primarily on three factors: (1) the unit's branch, (2) the total weight of unit equipment (a proxy for the unit's size), and (3) the mode of transportation from the CONUS to the overseas theater. Numerous other factors were considered, but they did not change the results significantly once the above three factors were taken into account.

Units deploying by air have less flexibility than those deploying by sea. They must be validated on all post-mobilization requirements before their air transportation can be scheduled. Sea-deploying units can defer some validation requirements because training or other activities can continue while the unit's equipment is in transit. Thus, for sea-deploying units, tasks requiring unit equipment can be scheduled early in the preparation cycle, and individual tasks delayed until the later stages.

Predictions from our analysis models indicate that most types of support units can be validated for air deployment in 8 to 16 days depending on their size; 3 to 9 days more may be needed for a few specific types of units. The time required to schedule airlift, prepare equipment, and move units to the Air Port of Embarkation is 5 to 8 days. Thus, units can be at the airport, ready to deploy, in 13 to 24 days depending on unit size.

With sea deployments the process is more complex because unit equipment is typically shipped in the middle of the process while unit personnel remain in the United States undergoing further

training. The key variable in determining when a unit can be in the theater of operations is the time it takes to get its equipment to the sea port. The analysis presented here indicates that typical units going by sea can have their equipment at the port in 18 days. Units belonging to some branches required 2 to 4 days less time, and artillery units required about 8 days longer. The models also indicate that a typical unit can complete training and validation in 24 to 29 days after call-up, depending on unit size (although again, certain types of units such as artillery take longer, as much as 42 days in total).

Using the methodology developed in this report, we illustrate its use by applying it to a notional Southwest Asia scenario to determine the allocation of units between the Active and Reserve Components. For example, considering a single type of unit, medium truck companies, our methodology shows that of the 19 total truck companies required by the scenario, only the four companies required within the first 30 days of the deployment must come from the AC. RC units could fill the remainder of the requirement, almost 80 percent, provided they are mobilized promptly when the deployment begins. Looking at the same contingency force as a whole, the scenario requires 180,000 support personnel for EAD and EAC support units, all of whom would have to come from the AC if there were no contribution from the RC. Since the notional AC force considered has only 74,000 support spaces available, it cannot meet the requirement without RC participation. Our methodology indicates that all but 37,000 of the support spaces could come from the RC, putting the scenario support requirement well within reach.

ACKNOWLEDGMENTS

This report was prepared with considerable input and assistance from the staff at Forces Command Headquarters (FORSCOM), the U.S. Army Reserve Command (USARC), and the office of the Army Chief of Staff. We owe particular thanks to General Edwin Burba, Commander in Chief, FORSCOM; Lieutenant General Horace Taylor, FORSCOM Chief of Staff during Operation Desert Shield; Major General Max Baratz, Deputy Commander, USARC; and Colonel Raoul Alcala, Office of the Army Chief of Staff. In one way or another, each provided access to information and enabled us to observe operations during the ODS call-up, forming the basis for the analyses in this report.

BACKGROUND

The effects of a collapsing Soviet Union have rippled across the world, and the United States has not been immune. Numerous changes have resulted from those effects, but none has been more visible than those in the defense establishment. No longer confronted with the formidable forces of a unified Soviet Union, the United States is reducing both its forces and its worldwide presence. As a result, many fundamental assumptions have changed. Nowhere is this change more apparent than in the Army, which has changed from a forward deployed force prepared to fight the Warsaw Pact, to an army based in the United States responsible for dealing with a range of contingencies. Such a fundamental change in outlook is causing the Army to reconsider virtually every aspect of its structure, training, and manning.

A key element in this reconsideration is the mix of forces between the Active Component (AC) and Reserve Components (RC). In the past, the reserves were essential to any conflict with the Warsaw Pact. Most future contingencies appear less demanding. Reserve forces offer considerable savings, an especially attractive characteristic in a time of shrinking budgets. But the nature of contingencies is that they frequently appear with no or only minimal warning. Forces to respond to them must maintain a high degree of readiness. What is the wisest course of action for the United States to pursue for its force structure? Should it attempt to save costs by increasing the Reserve Components, or should it regard them only as forces required

for general mobilization and maintain a smaller but highly ready active force?

Central to the determination of what force mix best serves the interests of the United States is the readiness of a given force to deploy. Decisions about the size, composition, and missions of both AC and RC will be driven in part by expectations about the speed with which RC units can be mobilized and prepared for deployment into a wartime theater.

Although public attention often focuses on combat forces in such deployments, in fact support forces make up a larger and perhaps equally important part of the picture. Support forces, in our terminology, include such functions as artillery, engineers, military police, maintenance, and transportation. In peacetime, they make up more than half of the units in the Army. Moreover, many such units are required very early in projected contingencies, and given the future size of the Active Component, we can expect that many such support units will have to come from the RC. Thus it is important to understand the times they will take to prepare for deployment in a contingency.

PURPOSE AND APPROACH

This report documents the results of RAND research into the issue of how long it takes to mobilize and prepare Army RC support units for deployment. Historically, this has been difficult to measure. The Persian Gulf War provided an unrivaled opportunity to garner quantitative data on deployment times for a number of units, including those in the RC. We recount analyses of the preparation times for RC support units based on statistical modeling of data from Operation Desert Shield (ODS), the preliminary build-up phase of that war. We then illustrate how the estimates from such models can assist in assigning functions to the Active or Reserve Components.

This study takes place within a larger series of RAND Arroyo Center analyses examining future Army structure and its active-reserve mix. RAND research has been examining this and related issues under a project on "force structures and the transition to war," whose analytic framework is depicted in Figure 1.

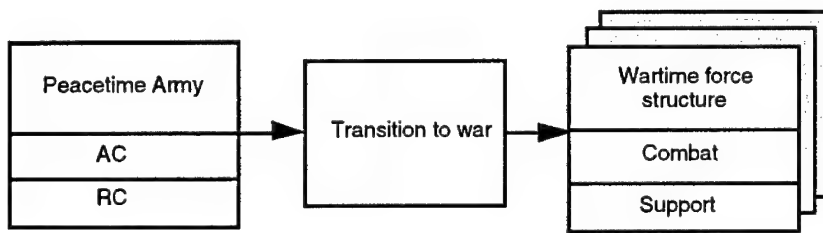


Figure 1 — Analytic Framework: Transition to War

This approach begins with a target wartime force structure for a particular theater; three such structures are represented at the right of Figure 1. They correspond to different locations or conditions in which U.S. forces might be used, such as Southwest Asia, Korea, or Europe. Typically, the planned wartime structure depends on an illustrative scenario for the conflict and prescribes the number of combat elements (e.g., divisions or separate brigades) required in theater over time after the beginning of a crisis. The combat structure must be fleshed out with an associated structure of supporting units (e.g., engineers, maintenance, medical, or transportation). We wish to determine the type of *peacetime* Army structure (including AC and RC elements) that can meet the requirements for deploying forces into a theater. Analysis of this issue depends crucially on the “transition to war” process, by which peacetime AC and RC units prepare for deployment. That process, as shown by the experience of the RC call-up during Operation Desert Shield, can be lengthy for some types of reserve units.

This study estimates preparation time for RC support units. In our terminology, support units are those located at Echelons Above Division (EAD). They include combat support (CS) functions, such as engineering and artillery, and combat service support (CSS) functions, such as maintenance, medical, transportation, water services, and the like. Although divisions also include organic elements that provide support functions for the division (the forward support battalions, for example), we do not deal with those elements here, since the Army typically treats a combat division as an entity.

Support units represent a large part of the force. In fact, our analyses of theater requirements indicate that EAD and Echelons Above Corps (EAC) support units can account for as much as two-thirds of the

ground force delivered into a combat theater. The bulk of all reserve forces called to duty in the Persian Gulf War were support forces. In addition, some support elements are needed very early in any contingency; port operators, for example, were needed within days during ODS.

ORGANIZATION OF THE REPORT

The remainder of this report is organized into five sections. Section 2 provides an overview of ODS from the perspective of this study and describes the mobilization process followed by a typical RC unit in preparing for that operation. Section 3 describes the database used to support the quantitative analysis of the preparation times. Section 4 presents that analysis for units deploying by air and sea. Section 5 offers an example illustrating how the approach used here can help determine the division of support units between the Active and Reserve Components. The final section offers conclusions.

THE MOBILIZATION PROCESS

This section provides an overview of Operation Desert Shield and the opportunity it provided to study the process of activating Reserve Component units. It also summarizes the various phases of the mobilization process that moves a unit from its peacetime status and location to a wartime footing.

OVERVIEW OF OPERATION DESERT SHIELD

For nearly 20 years, Reserve Component forces have played a crucial role in U.S. defense planning. During the 1970s and 1980s, many RC Army units were expected to deploy quickly and in close association with active units in a possible European or global conflict. They were also expected to play a role in any major contingency operation. However, the role of the RC units in this planning has inspired considerable debate about their ability to mobilize and deploy quickly—particularly given their dispersion in varied locations around the country and the limitations on their training opportunities in peacetime.

Operation Desert Shield provided a unique opportunity to bring quantitative data to the debate. Historically, the military has had only sparse data to assess the overall readiness of RC units and the time required to ready them for deployment. These issues are likely to be important as the Army considers how to reduce its overall size and yet still prepare for a variety of uncertain future contingencies.

ODS occasioned the first call-up of RC forces in more than 20 years. It also marked the first use of Presidential authority to call reservists

to active duty without having to declare a national emergency.¹ On 22 August 1990, 20 days after Iraq invaded Kuwait, the President signed Executive Order Number 12727 exercising his authority to call up to 200,000 Selected Reservists for as long as 180 days.² He delegated authority to call up to 48,800 reservists to the secretaries of the Army, Navy, and Air Force; the Army share was 25,000. On 1 December 1990, he increased the authorization to 188,000; 115,000 were Army members.

On 16 January 1991, the President authorized a partial mobilization. This action removed the 200,000 limit on the number of reservists that could be on active duty under Presidential authority, permitted the retention of reservists beyond the previous 180-day limit, and permitted the involuntary recall of Individual Ready Reservists. By the time combat operations began, over 222,000 reservists from all services had been called to active duty. On 19 January, the limit was raised to 365,000.

By the end of June 1991, the Army had activated 1,045 units with 145,500 Selected Reservists and almost 22,000 additional individual reservists. Of the 1,045 Army units called, 294 were activated to augment the CONUS base; the remaining 751 were deployed (43 to Europe and 708 to Southwest Asia). All of the units deployed from the Army RC were serving at EAD or EAC.³ The remainder of this report will focus only on the 751 reserve support units called for deployment.

Army forces were mobilized in two distinct phases, reflecting the gradual and phased mobilization process discussed above. The ini-

¹Title 10 USC (Section 673b) provides statutory authority for the President to activate up to 200,000 members of the Selected Reserve for an operational mission for up to 180 days, at times other than during war or national emergency. Section 673b was first enacted in 1976 under Public Law 94-286 and authorized the call-up of 50,000 Selected Reservists for up to 90 days. Until ODS, the authority had never been exercised. The authority was amended twice. Public Law 96-584 in 1980 increased the call-up to 100,000 and Public Law 99-661 in 1986 increased the call-up to 200,000 and provided for a 90-day extension.

²The following information is taken from the report of the Department of Defense (1991), p. 11-1.

³About 13,000 Army National Guard personnel were called from three combat brigades during November and December 1990, but these units underwent training in the United States and did not deploy before the war ended.

tial phase began with the Presidential authorization on 22 August and resulted in the call-up by mid-November of 236 units. This phase included units for the "minimum essential force," that is, a force large enough to give the Commander in Chief, Central Command (CINCCENT) the capability to receive forces and to defend Saudi Arabia. The RC units mobilized during this phase were types that provided critical support functions, such as military police, chemical, transportation, linguistic, medical, ordnance, and quartermaster units. The next phase of the mobilization was undertaken under the expanded authorities granted on 1 December and 16 January. It included another 515 units called for possible deployment as part of an "enhanced package." This was designed to give the theater the capability to conduct offensive operations.

This phased approach, very different from the sequence and scenario envisioned in previous planning for the mobilization of reserve forces, presented situations and challenges not fully considered in mobilization plans and procedures. Since future contingencies may also require reserve forces, it is valuable to examine the ODS mobilization experience to see what lessons it may hold for ensuring the readiness of future reserve support units. ODS also had some particular features, such as transportation slippages, that affected the way we analyzed unit preparation times.

Although the observations of this study apply to the ODS experience, two caveats should be borne in mind when interpreting them for the future Army. First, the requirements and timing for most unit types were such that the Army could afford to be selective, picking the units that appeared to be the most capable or ready. If the Army had needed to call a larger group of units or if the timing had been more compressed, it might have encountered more problems. Second, the ODS deployment was an intensively managed process, which received large infusions of effort and resources to ensure success. In 1990, the Army had an inventory that had been built and supplied to fight the Warsaw Pact, with a rich array of resources. The future Army will be smaller and the same resources may not be available to correct deficiencies. To compensate, it may become necessary to identify early-deploying RC units and resource and train them to minimize the need to correct deficiencies.

THE MOBILIZATION AND DEPLOYMENT PROCESS

The process of moving an RC unit from its routine peacetime status to a wartime one includes five phases:

- Preparation,
- Alert,
- Mobilization at home station,
- Movement to mobilization station, and
- Operational readiness improvement.

Units deploying overseas go through three additional phases:

- Movement from mobilization station to the Port of Embarkation (POE),
- Movement from the POE to the Port of Debarkation (POD), and
- Movement from the POD to the staging area.

Figure 2 graphically depicts phases and main events in the mobilization and deployment of reserve units.

The first phase, **Preparation**, includes those activities RC units routinely accomplish during peacetime. These actions include administrative and personnel activities such as maintaining personnel finance and medical records, preparing wills and family care plans, and accomplishing physical examinations and immunizations. The unit also trains to attain and sustain the individual and collective skills needed to accomplish its wartime mission. Other activities are directed at maintaining unit equipment and planning for mobilization and movement of the unit to the mobilization station.

The **Alert** phase begins when a unit receives notice of a pending order to active duty and concludes when the unit actually receives its mobilization order and enters federal service. Upon alert, with available personnel and other resources, the unit completes administrative and processing actions begun during the preparation phase. Unit members are alerted, records are screened to determine completeness and accuracy, and actions are initiated to prepare for mobilization at home station.

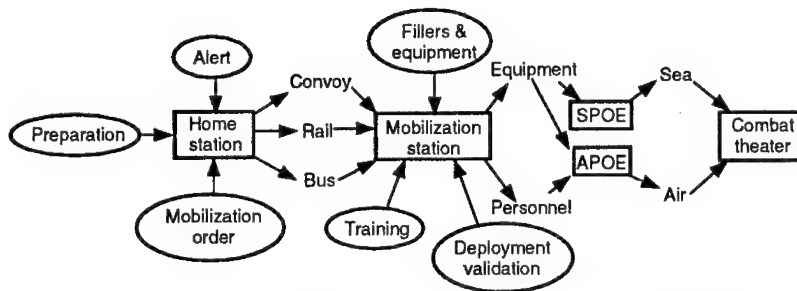


Figure 2 — Phases of Mobilization and Deployment for Reserve Units

Mobilization at Home Station begins with the order to enter active duty and ends with the unit moving to the mobilization station (or, in a minority of cases, directly to the POE). Activities include assembling all unit members, accomplishing administrative actions, updating the Unit Status Report (USR) to indicate current resources and capabilities, conducting some training, reviewing mobilization station support requirements (e.g., ammunition and supplies that will be needed for further training), and preparing to move to the mobilization station. During ODS, many units received filler personnel to eliminate shortfalls. These personnel were typically volunteers from the Individual Ready Reserve (IRR) or other RC units.

Movement to the Mobilization Station from home station is the next stage. Typically, a unit drives its own wheeled vehicles to the mobilization station when it is within a one-day road march. Personnel and equipment that cannot be moved by the unit's own transportation or that cannot sustain a motor march are moved by commercial transportation such as rail or truck.

The **Operational Readiness Improvement** phase begins when the unit arrives at its mobilization station. It concludes when the mobilization station commander (typically an active duty general officer) judges that the unit is ready to deploy. The goal of this phase is to meet the minimum deployment criteria as soon as possible. It involves three major activities. The first activity is to complete the transition of unit members to active duty and prepare for overseas movement (POM). This includes updating personnel records, con-

verting to the active component personnel and finance system, and completing physical examinations, dental treatment, immunizations, etc. In addition, the USR is updated, personnel and equipment shortfalls are identified, and steps are taken to fill those shortfalls. In the future, steps could be taken during peacetime to minimize the time required for this activity, especially for those units identified as early deployers.

The second major activity during Operational Readiness Improvement involves completing the individual and collective training required to meet deployment criteria. These criteria include general combat preparation (e.g., improving fieldcraft and survival skills) and developing special knowledge and skills related to the overseas mission (e.g., practicing use of chemical protective gear, coping with the specific nature of the terrain or enemy, and becoming familiar with local culture in the theater). The scope and level of that training will vary according to the initial evaluation made by the mobilization station authorities. For units going by sea, initial training would focus on activities that require the unit's equipment; this would permit the equipment to be shipped as soon as possible. There would then be time to complete other training while the equipment was in transit to the combat theater.

Finally, the unit prepares equipment for overseas movement and completes security briefings, prepares battle books and standard operating procedures, establishes plans for linking up personnel and equipment in the theater, and in general prepares for combat operations. Technically, this phase is completed when the unit is validated for deployment by the mobilization station commander.

The criteria for validating mission equipment readiness, personnel strength, status of personnel records, and medical readiness are straightforward and, in the main, well understood. During ODS, CINCCENT and Forces Command (FORSCOM) had promulgated guidance on special personal equipment required for the theater. These requirements included such items as desert camouflage uniforms and chemical protective gear. Validation of training status is more subjective. The criteria used in ODS varied somewhat across mobilization stations but, again, CINCCENT and FORSCOM had issued some guidance that addressed such areas as chemical training and theater familiarization.

A particularly important aspect of this process is whether the unit deploys by air or by sea. During ODS, for example, units going by air had to complete validation three to four days before departure. This timing allowed the joint deployment system to set the final requirement and schedule the airlift. Deployment began when the unit departed the mobilization station for the APOE.

In contrast, units going by sea typically underwent a two-part preparation process. During the Operational Readiness Improvement phase, the unit trained with its equipment and then the equipment was moved to the Sea Port of Embarkation (SPOE). Thereafter, the unit personnel remained behind and continued training until full validation. They then moved to their Air Port of Embarkation (APOE).

The final **Movement** processes are straightforward. Following movement to the POE, the unit travels overseas to the POD in the combat theater. It then completes deployment by collecting its equipment and moving from the POD to its staging area.

This section describes the types of units that participated in ODS, identifies the sources of our data on them, and defines the key special variables that we created to represent the unit preparation process.

NUMBERS AND TYPES OF UNITS

The most relevant sources of data are the records of the 708 Army Reserve Component support units that deployed to Southwest Asia during ODS. We obtained data from FORSCOM and Department of the Army files showing the key stages through which these units passed and the time it took for them to move through each stage. We were able to obtain complete information on 606 of the units, which formed the basis for the following analyses. The 102 units excluded either had key data elements missing or elements that were obviously in error.¹

Tables 1 and 2 display counts of the units on which data were available. These tables distinguish several features of units that will be important in the later analyses: the branch of the unit, whether the unit moved to the theater by air or by sea, and the phase of deployment. Different branches, of course, represent widely varying types of skill and, in some cases, different levels of organizational complexity (e.g., artillery battalions compared with medical detach-

¹Excluded units were examined and their characteristics were such that no bias in analysis results would be expected.

Table 1
Number of Units by Branch Deploying by Air

Branch	Total
Adjutant General	19
Aviation	5
Civil Affairs	9
Chemical	2
Composite Support	21
Engineer	18
Finance	1
Judge Advocate	4
Logistic	2
Medical	77
Military History	7
Military Intelligence	8
Military Police	54
Ordnance	7
Public Affairs	5
Quartermaster	26
Transportation	56
Total	321

Table 2
Number of Units by Branch Deploying by Sea

Branch	Total
Adjutant General	2
Army Security	1
Aviation	2
Chemical	7
Composite Support	56
Engineer	22
Field Artillery	8
Medical	40
Military Police	29
Ordnance	10
Quartermaster	28
Signal	1
Transportation	79
Total	285

ments). Similarly, the mode of transport has broad implications for the sequence of training activities. Air-transported units must be fully trained and validated before they can move either equipment or personnel. In contrast, sea-transported units typically trained at the mobilization station on their organic equipment for a period of time, and then shipped equipment to the port; the personnel remained behind and had additional time to complete training and validation while the equipment was in transit to the theater.

Differences between phases were also important to interpreting the results for future planning purposes. In Phase 1 particularly, the Army was under pressure to move critical units by air to the theater as quickly as possible. The scheduling and execution of airlift was not a particularly important constraint to deploying Phase 1 units, in part because the military owned or controlled a large air fleet and had practiced the management of such movements in the past. Although the schedules were still pressing in Phase 2, we observed that air-transported units were allowed more time to prepare than previously. Thus, we tend to view the Phase 1 data for air-deploying units as the most pertinent for future planning. However, for sea-transported units, transportation was quite constrained and somewhat disorganized during Phase 1. The military needed to secure sealift from many sources (including U.S. and foreign civilian sources), under a process never used before. Thus, some sea-transported units may have been allowed more time to get ready than was really necessary during Phase 1 (since sealift was unavailable or uncertain in some cases). Over time, the process became well-organized and schedule slippages lessened. Therefore, in the case of sea-transported units, we view the data from Phase 2 as more likely to produce useful estimates of future unit preparation times.

VARIABLES DESCRIBING THE DEPLOYMENT PROCESS

Table 3 shows several key points in the mobilization and deployment process, representing dates when each unit passed a certain point.

Most of these stages correspond directly to primary points in the mobilization process as described in the preceding section. The last item pertaining to the TPFDD (Time-Phased Force Deployment Data), however, may require some elaboration. From our observa-

Table 3
Deployment Variables

Variable	Source ^a
Call-up; receipt of mobilization order	FORSCOM ODS Reserve Unit Mobilization Summary
Home station arrival	FORSCOM Mobilization Station Planning System
Mobilization station arrival	FORSCOM ODS Reserve Unit Mobilization Summary
Validation	FORSCOM Deployment Status Report
Ready to load date; equipment ready to leave the mobilization station	TPFDD
Equipment Arrival at POE	FORSCOM ODS Reserve Unit Mobilization Summary
Latest arrival date (LAD) in theater	
Predicted LAD (PLAD)	LAD from first TPFDD containing unit
Actual LAD (ALAD)	LAD from 28 February 1991 TPFDD (the last TPFDD in the war)

^aAll data sources based on Time Phased Force Deployment Data; the Mobilization Station Planning System; and the Deployment, Employment, Mobilization Status System. Descriptions of these systems may be found in U.S. Army Forces Command (1986).

tions during ODS, we expected that some units would experience deployment delays because of changing priorities of the CINC, unforeseen transportation shortages or delays, or other bottlenecks in the process, even though the unit itself might be ready to deploy. These factors in fact did delay the departure of unit equipment in a number of cases. As a result, units that experienced such "slips" in their schedules may have appeared to take longer to prepare for deployment because they had to wait longer at their mobilization stations for transportation.

These delays would obviously be important in an overall assessment of the deployment system's capabilities. For our purposes, however, we wanted to isolate the time required strictly to *prepare the unit for*

war. To address this, we determined the original target date when the unit was planned to arrive in theater and compared it with the actual arrival date from the final TPFDD. From this we calculated a "slip" period, denoted by the following variable that was used to control for slippage in the regression analyses as an independent variable:

- Slip = PLAD – ALAD

In addition, the process appeared to be somewhat different between Phase 1 and Phase 2 because in some ways Phase 2 was less rushed and more time was allowed for some activities. We also wanted to determine if there were differences between units deploying from the West Coast and those deploying from southern and eastern ports. To control for such factors related to phase and SPOE location, we included the following control variables in the analysis:

- Phase: An indicator variable equal to zero if the unit was called in Phase 1 and equal to one if it was called in Phase 2.
- West: An indicator variable equal to one if deployment was from the West Coast and equal to zero otherwise.

VARIABLES DESCRIBING UNIT CHARACTERISTICS

To develop a way to predict the length of time required to prepare a unit for deployment, we collected information on a variety of unit characteristics thought to affect unit readiness and training status. These variables are shown in Table 4. They include, for example, indicators for the unit's branch or type (e.g., composite services, including maintenance and some supply functions, engineering, and military police) and indicators for the transport mode (air or sea). We examined various measures of a unit's size based on the thesis that larger units would take longer to prepare for deployment. Total equipment weight consistently proved to be a significant predictor, but other measures of size, such as number of people assigned, did not add predictive power when unit weight had already been considered. As shown in Table 4, we also considered the component (Army National Guard or U.S. Army Reserve), the Authorized Level of Or-

Table 4
Unit Characteristic Variables

Variable	Source
Unit size; weight in short tons	TPFDD, aggregated by Unit Identification Code
Unit branch indicator variables (CS, EN, MP, etc.)	M-Force database ^a
Transport mode (air or sea)	FORSCOM Reserve Unit Mobilization Summary
Component (USAR or ARNG)	M-Force database
ALO	M-Force database
Resource and training level ("C- ratings"—overall and individual ratings for personnel, equipment on hand, readiness, and training)	SORTS data, ^b report made immediately before call-up

^aMaster Force (M-Force) data are part of the U.S. Army Force Accounting System described in U.S. Army Force Development Support Agency (1988).

^bDepartment of the Army (1986). These reports are generated by the unit commanders and before ODS U.S. Army Reserve units reported semi-annually and U.S. Army National Guard units reported quarterly. The "C-ratings" reflect percentage fill of resources, such as personnel and equipment: C-1 = 90 percent, C-2 = 80 percent, and C-3 = 70 percent for personnel or 65 percent for equipment. The rating for training represents the commander's estimate of post-mobilization train-up time.

ganization (ALO, indicating peacetime resourcing priority),² and various measures of peacetime resource levels taken from the SORTS databases (Status of Resources and Training, the official reporting system used by the Joint Staff). Although these latter measures have a number of well-known limitations,³ we included them to allow for the possibility that they might significantly improve prediction of preparation times.

²ALO represents the authorized level of resources (personnel and equipment) for an individual unit: ALO 1 = 98 to 100 percent; ALO 2 = 88 to 97 percent; and ALO 3 = 78 to 87 percent.

³Moore et al. (1991).

ANALYSIS OF PREPARATION TIMES

This section presents the quantitative analysis of the time required for various phases of the mobilization process, based on the unit characteristics discussed in Section 3. We first briefly outline the time required for the initial part of the process, the portion from call-up to reaching the mobilization station. All units performed nearly identically in this portion of the process. We then examine the rest of the process in more detail, separating the results by mode of transportation (air or sea) and showing regression analyses that identify the primary factors affecting preparation times.

INITIAL CALL-UP AND MOBILIZATION STATION ACTIVITY

The time required for a typical unit to assemble at home station and move to its mobilization station after call-up was 3 days.¹ The best estimator of the time required was the mean, and none of the unit characteristics or control variables described in Section 3 had a statistically significant effect on this time. Also, there was no significant difference between those units going by air and those going by sea.

We were not able to obtain specific unit-by-unit data on the time used at the mobilization station for initial individual-level activities, such as POM. However, our visits to mobilization sites during ODS and our subsequent interviews with participating officers and managers yielded general agreement that approximately 1 to 3 days were

¹Only 23 units out of the 606 units analyzed had a time from call-up to arrival at the mobilization station different from 3 days.

needed to complete POM activities. In later descriptions of the process, therefore, we will allocate 3 days for the period from mobilization order to arrival at the mobilization station, and 1 to 3 additional days for POM.

ANALYSIS OF THE STAGES OF UNIT PREPARATION

The remainder of this section describes the later stages of the unit preparation process—those concerned with collective training, validation, and preparation of equipment for shipment. The key time-point in the mobilization process, for purposes of future contingency planning, is when the unit equipment arrives at the APOE or SPOE. Future analyses of unit preparation and deployment must begin with this time to simulate the process of moving forces into a combat theater, considering lift availability, the CINC's time-phased force requirements, and other factors. Therefore, the following analysis focuses first on the time to reach APOE or SPOE. However, in addition we will examine two other major time-points—unit validation and the unit's ready-to-load date (RLD)—which are often thought of as major drivers of the unit preparation process. The validation date, as described in Section 2, is particularly important for units going by air because, typically, air transport cannot be finally scheduled until validation is complete. For units going by sea, the RLD is particularly important because on that date the unit is ready to move its equipment to the SPOE. If sealift is available, it is the date that determines when the unit can be in theater. Unlike units going by air, units going by sea can complete the validation process while their equipment is in transit to the theater. Knowledge of these times helps planners to interpret the preparation process and to explain what occupies the time required.

Throughout, our analyses found that only three unit variables produced independent contributions to explaining the preparation times. Those variables were (1) the unit's branch (e.g., artillery, military police, transportation), (2) the total weight of unit equipment (a proxy for the unit's size), and (3) the mode of transportation from the CONUS to the overseas theater (air or sea). Although numerous other factors were considered, they did not add significant predictive power to the equation after these three factors were taken into ac-

count. The control variables of slippage, phase of the operation, and coast of departure also proved to be significant in some instances.

UNIT PREPARATION: DEPLOYMENTS BY AIR

Call-Up to Equipment Arrival at APOE

We used regression analysis to estimate elapsed time between call-up (issuance of a mobilization order) to arrival of equipment at the APOE. For this analysis, we examined the 321 units that went by air in both phases of ODS. The following equation summarizes the results for predicting this time.² The equation includes only those variables that proved statistically significant (at the .10 level).

$$\begin{aligned} \text{Time to APOE} = & 13.24 + (0.60)(\text{SWT}) + (-2.47)(\text{AG}) \\ & + (7.86)(\text{CM}) + (3.53)(\text{CS}) + (4.38)(\text{MP}) + (3.71)(\text{QM}) \\ & + (2.99)(\text{PH2}) + (0.12)(\text{SLIP}) \end{aligned} \quad (1)$$

where

- SWT = square root of weight (short tons),
- AG = indicator for Adjutant General branch,
- CM = indicator for Chemical branch,
- CS = indicator for Composite Services branch,
- MP = indicator for Military Police branch,
- QM = indicator for Quartermaster branch,
- PH2 = indicator for Phase 2 of ODS, and
- SLIP = slippage in schedule (days).

Numerous other unit characteristics were considered (e.g., component, ALO, SORTS readiness indicators, and so forth), but they did not have significant effects. This outcome was not expected, but there are two probable reasons for it: (1) Support units were required only to be C-3 for deployment to ODS, and very few units that were

²Details of the regression are shown in the appendix.

called were at C-4.³ (2) According to those at FORSCOM who managed the mobilization and deployment, most resource shortfalls were known before or shortly after call-up, and plans to correct deficiencies (e.g., cross-leveling) were developed or under way by the time a unit arrived at its mobilization station. In many cases deficiencies were corrected after the unit was alerted and were completed before receipt of the mobilization order. In a sense, units were "pre-validated" for most resources before they were called up.

The results show that in general the time elapsed from call-up to arrival at the APOE depends on the unit's equipment weight,⁴ with adjustments for branch in the case of adjutant general, chemical, composite services, military police, and quartermaster units. Branches not included in the above equation were not statistically different (see Table 1). The adjustments for the branches shown are relative to all other types of units. Thus, on average, adjutant general units required about 2.5 days less than other types of units, whereas chemical units required almost 8 days more. The analysis also indicates that units took about 3 days longer in Phase 2 than in Phase 1, which we attribute to the relaxation of time pressures during that latter part of the air-deployment operation. Transportation schedule slippages also affected the estimate; for each day the eventual LAD was slipped, our estimate suggests that the time to APOE increased by 0.12 days.

This equation should be used, in future applications, by setting PH2 and SLIP to zero. That is, when one's interest is in planning for future deployments and estimating the time to prepare a unit (without regard to transportation availability), one should evaluate the function above using only the weight and branch variables. This assumes in effect that conditions are similar to those of Phase 1 of ODS and that there will be no transportation slippage.

³C-3 means that the unit has at least 70 percent of its personnel and 65 percent of its equipment. C-4 means that the unit's resources are below these levels and the unit is not deployable. Since most units called during ODS were better than C-3, readiness indications and ALO would have little effect on preparation time.

⁴In the initial analysis, we examined a purely proportional (linear) relationship with weight, but found from an analysis of residuals that a function such as the square root of weight would be a better predictor. This means that the time to APOE is not strictly proportional to unit size. See Figure 3, below, to illustrate this point.

Call-Up to Validation

Units needed to be validated before air transportation could be scheduled and their equipment moved to the APOE. To investigate factors that might affect the validation time, we also ran a regression predicting time from call-up to validation. Equation (2) shows the result of this analysis.

$$\begin{aligned} \text{Time to validation} = & 8.16 + (0.44)(\text{SWT}) + (9.19)(\text{CM}) \\ & + (2.60)(\text{CS}) + (3.23)(\text{MP}) + (4.07)(\text{QM}) \\ & + (1.25)(\text{PH2}) + (0.19)(\text{SLIP1}) \end{aligned} \quad (2)$$

where

- SWT = square root of weight (short tons),
- CM = indicator for Chemical branch,
- CS = indicator for Composite Services branch,
- MP = indicator for Military Police branch,
- QM = indicator for Quartermaster branch,
- PH2 = indicator for Phase 2 of ODS, and
- SLIP1 = interaction between Phase 1 and schedule slippage (days).

Generally, this result is quite similar to that for arrival at APOE. Most of the same variables are significant. In addition to the difference in intercepts (8 compared with 13 days), this result also shows a smaller coefficient for weight. Thus, the lag time between validation and arrival at APOE will increase as the unit weight increases. For example, a typical unit weighing 150 tons would need 14 days to validate and 21 days to reach the APOE.⁵

⁵We also analyzed the time between validation and arrival at the APOE, and the results were essentially the same as the difference between Eq. (1) (for call-up to APOE) and Eq. (2) (for call-up to validation).

Description of the Full Process for Air-Transported Units

Figure 3 illustrates the predictions that can be made from the preceding observations and equations for a typical unit.⁶ We can see from this figure that the time from call-up to validation ranges between 8 to 16 days depending on unit weight. And, the time between validation and arrival at the APOE varies from about 5 to 8 days depending on weight. During this time, the unit prepares its equip-

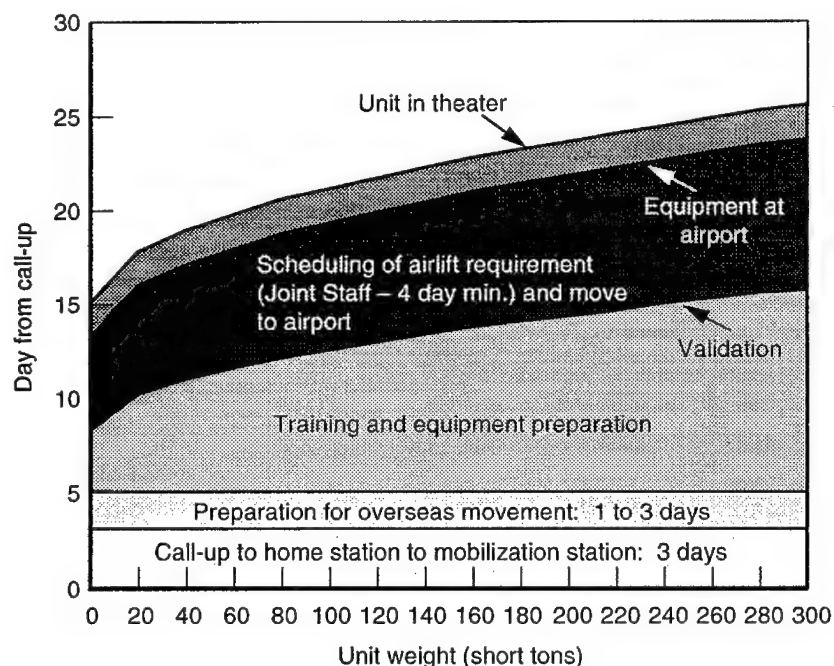


Figure 3 — Estimated Average Preparation Time for RC Support Units Deploying by Air in Phase 1

⁶The figure applies to all branches that do not receive special adjustments in the above equations. Adjustments for specific branches that are not typical would need to be made according to the coefficients in the equations.

ment for shipment and moves from the mobilization station to the APOE. These times seem to be somewhat longer than expected since the units going by air are generally small.⁷ The times may be explained, in part, by the Joint Staff requirement for at least 4 days notice before the planned departure to produce the final airlift schedule. This could account for part of the time and it may also be possible that units were able, on average, to get ready well before their required departure date. But, we also note that larger units took longer than smaller units from validation to arrival at the APOE.

Three plausible explanations for this are: (1) It may take heavier units longer to prepare their equipment for transport, (2) it may take longer to move the heavier units from the mobilization station to the APOE, or (3) it may take longer to schedule sufficient airlift for the heavier units. We have no data describing exactly when a unit left its mobilization station for the APOE, but data for units deploying in Phase 2 indicate when the units were to have their equipment ready to load, i.e., ready to depart the mobilization station.

As shown in the appendix, we conducted a similar regression analysis predicting time from call-up to the ready-to-load date (RLD), using the unit characteristics and control variables described above as independent variables. Because of the available data, we were limited to the 231 units in Phase 2. The results indicate that typical units in Phase 2 were spending an average of 2.3 days (independent of weight) after validation to prepare their equipment and personnel for movement from the mobilization station. The total time from validation to APOE for Phase 2 ranged from 6.7 to 9.7 days. This leaves 4.4 to 7.4 days between RLD and arrival at the APOE during Phase 2. The time in excess of the four days required to schedule the airlift may be explained by one of the preceding hypotheses, or may simply be slack time, but we have no additional data to shed light on the actual causes.

There was a great deal of variance around the estimates provided by these equations.⁸ This was caused, in part, because many activities and actions that are not captured by the data we have available af-

⁷Ninety percent weighed less than 120 short tons.

⁸This is indicated by the modest size of the R-squared values, as listed in the appendix.

fectured individual units. Because, in the future, we will be selecting units of a particular type from a large pool using a range of different criteria, we believe that these equations are appropriate for use in planning unit preparation time.⁹

We recommend using Eq. (1), the time from call-up to equipment arrival at the APOE, to help judge whether a particular unit requirement in the scenario of interest can be filled with a Reserve Component unit. That formula can be used in conjunction with the estimated load, air transport, and unload times to assess the probable time needed to mobilize and deploy a unit to theater. For this purpose, the Phase 1 time should be computed, since our experience suggests that slightly more time was taken in Phase 2 for air deployments, when immediate arrival in theater was, in most cases, not as critical.

UNIT PREPARATION: DEPLOYMENTS BY SEA

Special Features of the Sea-Deployment Process

The process of deploying by sea is somewhat different from the air-deployment process. Because of the lengthy sea transit time, most units are under pressure to send their equipment to the SPOE, even though the personnel may still need some additional training or administrative actions. During ODS, the Army typically dealt with this problem by following a four-part process at the mobilization station:

- Train the unit with its equipment at the mobilization station, until a reasonable degree of proficiency is achieved.
- Ship the equipment to the SPOE, from which it begins its voyage to the theater.
- Meanwhile, continue training the personnel until the unit is validated (either working on tasks that do not require the equipment, or using other equipment available at the mobilization station).

⁹We examined the 90 percent confidence band around the mean predicted value for these equations, and it varied from ± 1 to 1.5 days.

- After validation, move the personnel to an airport from which they can fly to the theater and rejoin their equipment.

Thus, the process was designed so that most units could ship their own equipment to the SPOE at a given time, confident that the personnel could complete training by their desired air departure date. In the case of a unit deploying by sea, this means that the time required to train on its own equipment and prepare the equipment for shipment is the key parameter in determining when the unit can ship to the combat theater. Therefore, we began examination of sea-transported units by examining the time required to reach the SPOE.

Call-Up to Equipment Arrival at SPOE

We again used regression analyses to model the time from call-up to the arrival of the unit's equipment at the SPOE. We used the same unit characteristics and control variables described above as independent variables. This analysis includes the 198 units on which we had data from Phase 2.¹⁰ The results for a typical unit appear below:

$$\begin{aligned} \text{Time to SPOE} = & 18.16 + (8.34)(\text{FA}) + (-3.09)(\text{CS}) \\ & + (-1.87)(\text{MD}) + (-2.27)(\text{EN}) + (-3.67)(\text{TC}) \\ & + (-2.43)(\text{WEST}) \end{aligned} \quad (3)$$

where

- FA = indicator for Field Artillery branch,
 CS = indicator for Composite Services branch,
 MD = indicator for Medical branch,

¹⁰As discussed above, during Phase 1 the sea-transportation process was frequently disrupted and rescheduled by sealift shortages; the units that went by sea took longer to get their equipment to the SPOE than those in Phase 2. Furthermore, reliable RLD were available only for those units deploying during Phase 2. It appears that in general the data are more reliable for Phase 2 and that the mobilization process had been tuned by that time. We believe that many of the lessons learned during ODS will be incorporated into the future management of sealift; therefore, the analysis of units transported by sea focuses on Phase 2. Should sealift problems similar to those in Phase 1 of ODS crop up in a future contingency, these time estimates could be somewhat optimistic.

EN = indicator for Engineering branch,
TC = indicator for Transportation branch,
WEST = indicator for West Coast departure.

This equation shows that the preparation process for units transported by sea was considerably longer than for units moving by air. The largest effects are for branch: Artillery units, in particular, required about 8 days longer than the typical unit to reach the SPOE. In addition, several other types of units (composite services, medical, engineering, and transportation) required 2 to 4 days less time than the average unit. Coefficients for other branches were not statistically significant (see Table 2). Also, the indicator variable for a unit embarking from the West Coast (rather than the east) took on a significant effect; West Coast units were apparently able to get their equipment to the port 2 days earlier than the typical unit.

In these results, unit weight does not play the same important role as in the case of air deployment. We again examined both weight and the square root of weight as independent explanatory variables. Neither was statistically significant, meaning that for units going by sea, unit size had little effect on the time from call-up to arrival at the SPOE.¹¹ This may reflect the fact that a unit going by sea did not have to be fully validated before its equipment could be shipped, as was the case for units going by air.¹² These results indicate that, on average, the units were able to train on their equipment, prepare the equipment for shipment, and move it to the SPOE within the times shown by the equations. As with units going by air, other unit characteristics such as component, ALO, and readiness indicators, as well as the control variable for schedule slippage, had no significant effect.

Call-Up to RLD

A very similar picture emerged when we modeled the time from call-up to RLD. As shown in the appendix, the same independent vari-

¹¹Clearly, unit type and the resulting type of training and preparation, as represented by the branch variable, had more effect than unit size.

¹²See below. Weight does have an effect on validation time.

ables were significant predictors of RLD, and the coefficients had magnitudes similar to those in Eq. (3). The primary inference is that a typical unit was ready to load 15 days after call-up, and on average, the equipment arrived at the SPOE about 3 days after the RLD.¹³

Call-Up to Validation

For units deploying by sea, the time to validate is less important than the time required to get the equipment to the SPOE. Units can complete validation while the equipment is en route. However, as with units going by air, units going by sea must complete validation before scheduling the airlift for unit personnel, and the airlift must depart at least 2 days before the equipment is due to arrive in theater by sea. During Phase 2 of the ODS mobilization, the majority of units did complete their validation after their equipment arrived at the SPOE but in all cases well before the airlift needed to be scheduled.

We ran a regression analysis with the time from call-up to unit validation as the dependent variable and the unit characteristics and control variables described above as independent variables. In this case, the weight of the unit did make a significant difference, but it was not a continuous function of weight as in the case of air shipment; rather, there were differences between units weighing more or less than 200 short tons.¹⁴ The result for a typical unit is shown below:

$$\begin{aligned} \text{Time to validation} = & 24.61 + (13.13)(\text{FA}) + (5.97)(\text{MD}) \\ & + (-5.02)(\text{EN}) + (4.76)(\text{HVY}) \end{aligned} \quad (4)$$

where

FA = indicator for Field Artillery branch,
MD = indicator for Medical branch,

¹³We also analyzed of the time between RLD and arrival at the SPOE, and the results were essentially the same as the difference between Eq. (3) (for call-up to SPOE) and the equation for call-up to RLD in the appendix. The slip variable had some effect but not enough to change the results in any significant way (about one-half day).

¹⁴Both weight and square root of weight were examined and neither was significant as a continuous function.

EN = indicator for Engineer branch,
 HVY = indicator for a heavy unit (over 200 short tons).

Summary of the Process for Units Deploying by Sea

The above equations and observations lead to a quite simple depiction of the preparation process for units deploying by sea. Figure 4 shows the preparation time for a typical unit. Normally, the unit would spend about 3 days assembling and reaching the mobilization station. At the mobilization station, it would begin POM activities, typically conducting them for about 3 days in parallel with unit and individual training. It would then continue until, at about day 15, the equipment was ready to load. The equipment would then be loaded and shipped to the port, and the unit would continue training until about day 29 (for a heavy unit). Then, the personnel would depart the mobilization station for the airport and move to theater by air. This picture, of course, needs to be modified using the above equation coefficients for units in specific branches that deviated from the average.

As with air-transported units, there was a great deal of variance around the estimates provided by these equations, partly because many activities and actions that affected individual units are not captured by the data we have. Because, in the future, we will be selecting units of a particular type from a large pool using a range of

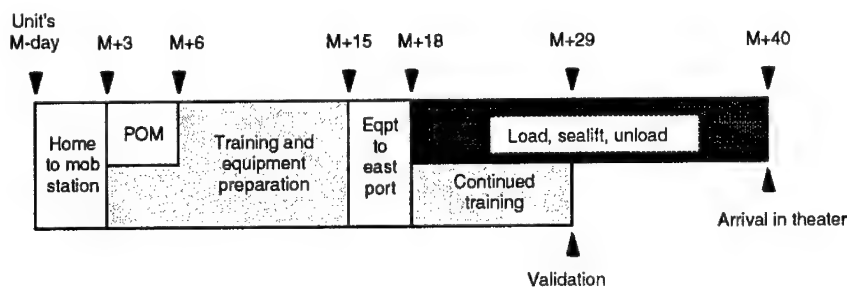


Figure 4—Average Preparation Time for Units Deploying by Sea

different criteria, we believe that these equations are appropriate for use in planning unit preparation time.¹⁵

In future planning, to judge whether a particular requirement can be filled with a Reserve Component unit, we recommend using the time from call-up to equipment arrival at the SPOE. This can be estimated from Eq. (3), in conjunction with estimated times for loading, sea transport, and unloading (which would depend on the particular scenario).

¹⁵We examined the 90 percent confidence band around the mean predicted value for these equations and it varied from ± 1 to 1.5 days.

ILLUSTRATIVE EXAMPLE

In this section we illustrate how estimates calculated using the methodology described in Section 4 can be used to determine the required AC-RC mix for a given scenario. Using the methodology to predict when various units can be ready to deploy, we can determine which deployment requirements to a given theater can be filled by RC units and which by AC units. This distinction is important, since RC units are less expensive to maintain than are AC units. However, RC units take longer to prepare to deploy. By estimating how long RC units will take to be ready to deploy, we can determine the minimum AC force size capable of meeting deployment requirements and thus derive an appropriate mix of AC and RC units of each type.

SINGLE UNIT ILLUSTRATION

A simple illustration shows how RC preparation times play a key role in developing an AC-RC mix for Army force structures. Consider medium truck companies in a Southwest Asia scenario. The scenario commences with deployment (C-day), and specifies, among other things, the time particular units are needed in theater. The methodology developed above estimates that typical units in the RC need 18 days, on average, before their equipment can be available at a port and ready to load on ships. Since it takes about 22 days, on average, for ships to load, transit, and unload cargo in Southwest Asia, RC units would need at least 40 days after mobilization before they could be available in that theater.

According to doctrine, as reflected in the Army's Force Analysis Simulation of Theater Administrative and Logistic Support (FASTALS) model, the combat forces required for an illustrative conflict in Southwest Asia should be accompanied by 19 truck units, which should arrive in the theater according to the following schedule:

- 2 units between C-day and C+20,
- 2 additional units by C+30,
- 2 additional units by C+40,
- 6 additional units by C+60, and
- 7 additional units by C+110.

Assuming, for the moment, that sealift is promptly available to move them, RC units could meet delivery requirements scheduled 40 or more days after M-day (the date when reserve units are mobilized). If M-day and C-day coincide, RC units could fill the requirement for 15 of the truck units called for in this scenario, i.e., about 80 percent of the contingency's requirement. The requirements for 4 medium truck companies needed before C+40 would have to be met using active duty units. A similar calculation could be followed for other types of support units required in the theater.

MULTIPLE UNIT ILLUSTRATION

Figure 5 shows the total personnel requirement for both combat forces and support forces at EAD and EAC, aggregated across all the individual types of units required in a hypothetical theater.

Using the same method illustrated for the medium truck companies above, we can determine the required AC-RC mix for each type of unit called for in our example scenario and then aggregate them by component. The results are shown in Figure 6. In this illustration we assume that mobilization is authorized on the same day deployments begin.

Note that if no RC units could be ready to meet any of the requirements, all would have to come from the AC. The AC would then need over 180,000 personnel in support units ready to deploy to this con-

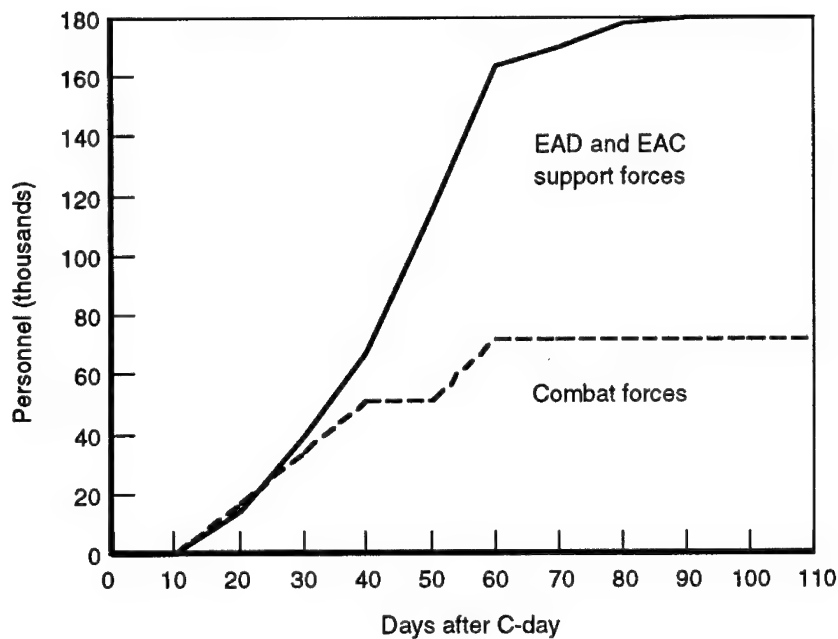


Figure 5 — Force Deployment Requirements for a Contingency Scenario

tingency. In the above case, however, if RC support units could be ready to deploy as predicted by our methodology, all but about 37,000 of the support requirement can be met with RC support units. The difference in the two cases is critical. The active duty force projected for this scenario contains 74,000 spaces for support in EAD and EAC units. In the first case, the active force could not meet the requirement; in the second, it can meet it handily.

The above illustrates the results for a single scenario and set of mobilization assumptions. Assumptions about when mobilization occurs, the requirements of other theaters, availability of transportation, and so forth would lead to different mix requirements. The key in all, however, is the ability to predict with reasonable accuracy how long RC units will take to prepare for deployment to the theater. The methodology described above provides a tool for doing that.

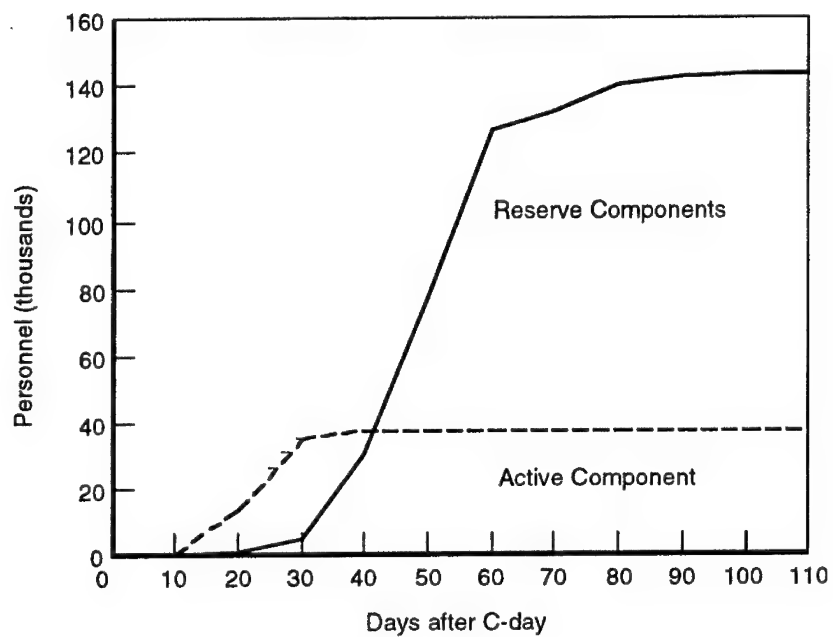


Figure 6 — AC-RC Mix for SWA Contingency

CONCLUSIONS

Our results show that Reserve Component support units can be prepared and mobilized for deployment in a matter of a few weeks. Using data from Operation Desert Shield, we found that the time required for the early phases of mobilization was similar for all units (3 days from call-up to reach the mobilization station and 1 to 3 days to prepare for overseas movement). The analyses showed that the time required for the other phases varied, depending primarily on three factors: (1) the unit's branch, (2) the total weight of unit equipment (a proxy for the unit's size), and (3) the mode of transportation from the CONUS to the overseas theater. Numerous other factors were considered, but they did not change the results significantly once the above three factors were taken into account.

Units deploying by air have less flexibility than those deploying by sea. They must complete validation of all post-mobilization requirements before their air transportation can be scheduled. Sea-deploying units can defer some validation requirements because training or other activities can continue while the unit's equipment is in transit. Thus, for sea-deploying units, tasks requiring unit equipment can be scheduled early in the preparation cycle, and individual tasks delayed until the later stages.

Predictions from our analysis models indicate that most types of support units can be validated for air deployment in 8 to 16 days depending on their size; 3 to 9 days more may be needed for a few specific unit types. The time required to schedule airlift, prepare equipment, and move units to the APOE is 5 to 8 days. Thus, units

can be at the airport, ready to deploy, in 13 to 24 days, depending on unit size.

With sea deployments the process is more complex because unit equipment is typically shipped in the middle of the process while unit personnel remain in the United States undergoing further training. The time the unit can have its equipment at the sea port is the key variable in determining when it can be in the theater of operations. Our analysis indicates that typical units going by sea can have their equipment at the port in 18 days. Units belonging to some branches required 2 to 4 days less time, whereas artillery units required about 8 days longer. Our models also indicate that a typical unit can complete training and validation in 24 to 29 days after call-up, depending on unit size (although again, certain types of units such as artillery take longer, as much as 42 days in total).

The models developed in this study should have useful applications in determining assignments of units to the different components in the military force structure. Knowing the requirements of a given scenario, the preparation times developed here can identify which units—AC or RC—can meet the required timelines.

Appendix

**REGRESSION ANALYSES OF UNIT PREPARATION
TIMES**

The following tables (A.1 through A.6) report statistical results from linear regressions predicting various aspects of unit preparation times. Analyses were conducted separately for units transported by air (N = 321, including both Phase 1 and Phase 2) and units transported by sea (N = 198 for Phase 2 only).

For each regression model, the tables display regression coefficients, standard errors of coefficients, and T-values with their associated probabilities. Definitions of the variables are found in Section 3 and discussion of the results in Section 4.

Table A.1

**Predicting Time from Call-Up to Arrival at Air Port of Embarkation
(Units Transported by Air)**

Variable	Coefficient	Standard Error	T	Probability
Intercept	13.240	0.750	17.647	.001
Weight (square root)	0.604	0.084	7.165	.001
Branch: Adjutant General	-2.470	1.403	-1.760	.079
Branch: Chemical	7.856	3.917	2.006	.046
Branch: Composite Services	3.526	1.335	2.649	.009
Branch: Military Police	4.375	0.895	4.887	.001
Branch: Quartermaster	3.706	1.230	3.013	.003
Phase 2	2.986	0.751	3.977	.001
Slip	0.119	0.048	2.483	.014

NOTE: $R^2 = .338$, N = 321 units (Phases 1 and 2).

Table A.2
Predicting Time from Call-Up to Validation
(Units Transported by Air)

Variable	Coefficient	Standard Error	T	Probability
Intercept	8.159	0.639	12.767	.001
Weight (square root)	0.438	0.070	6.226	.001
Branch: Chemical	9.195	3.328	2.763	.006
Branch: Composite Services	2.598	1.120	2.321	.021
Branch: Military Police	3.232	0.745	4.336	.001
Branch: Quartermaster	4.072	1.033	3.943	.001
Phase 2	1.249	0.633	1.972	.049
Interaction: Slip by Phase 1	0.192	0.063	3.066	.002

NOTE: $R^2 = .266$, $N = 320$ units (Phases 1 and 2).

Table A.3
Predicting Time from Call-Up to Ready-to-Load Date
(Units Transported by Air)

Variable	Coefficient	Standard Error	T	Probability
Intercept	11.717	0.802	14.605	.001
Weight (square root)	0.436	0.091	4.801	.001
Branch: Adjutant General	-3.822	1.508	-2.535	.012
Branch: Composite Services	3.889	1.776	2.189	.030
Branch: Medical	-3.309	0.866	-3.810	.001
Branch: Military Police	4.706	0.966	4.871	.001
Branch: Quartermaster	6.341	1.872	3.386	.001
Slip	0.245	0.054	4.527	.001

NOTE: $R^2 = .450$, $N = 236$ units (Phase 2).

Table A.4

**Predicting Time from Call-Up to Arrival at Sea Port of Embarkation
(Units Transported by Sea)**

Variable	Coefficient	Standard Error	T	Probability
Intercept	18.157	0.705	25.750	.001
West coast departure	-2.430	1.051	-2.311	.022
Branch: Field Artillery	8.343	1.914	4.360	.001
Branch: Composite Services	-3.087	1.085	-2.846	.005
Branch: Medical	-1.867	1.060	-1.762	.079
Branch: Engineering	-2.269	1.349	-1.682	.094
Branch: Transportation	-3.670	1.049	-3.500	.001

NOTE: $R^2 = .229$, $N = 198$ units (Phase 2).

Table A.5

**Predicting Time from Call-Up to Validation
(Units Transported by Sea)**

Variable	Coefficient	Standard Error	T	Probability
Intercept	24.605	1.417	17.361	.001
Weight (over 200 short tons)	4.762	1.641	2.902	.004
Branch: Field Artillery	13.133	3.941	3.332	.001
Branch: Medical	5.968	1.938	3.079	.002
Branch: Engineering	-5.018	2.644	-1.898	.059

NOTE: $R^2 = .173$, $N = 198$ units (Phase 2).

Table A.6
Predicting Time from Call-Up to Ready-to-Load Date
(Units Transported by Sea)

Variable	Coefficient	Standard Error	T	Probability
Intercept	15.010	0.635	23.636	.001
West coast departure	-1.909	0.947	-2.017	.045
Branch: Field Artillery	9.489	1.723	5.505	.001
Branch: Composite Services	-2.836	0.977	-2.903	.004
Branch: Medical	-2.199	0.955	-2.304	.022
Branch: Engineering	-2.862	1.215	-2.356	.020
Branch: Transportation	-3.099	0.945	-3.281	.001

NOTE: $R^2 = .272$, $N = 198$ units (Phase 2).

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